

MONTHLY WEATHER REVIEW

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for June, 1904, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph, and mail, 167; West Indian Service, cable and mail, 4; River and Flood Service, regular 43, special river and rainfall, 190, special rainfall only, 56; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 3025; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries, also printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. R. C. Lydecker, Territorial Meteorologist, Honolulu, Hawaii; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander H. M. Hodges, Hydrographer, United States Navy; H. Pitier, Director of the Physico-Geographic Institute, San José,

Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; Rev. José Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the Meteorological Service of the Republic of Cuba.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is $157^{\circ} 30'$, or $10^{\text{h}} 30^{\text{m}}$ west of Greenwich. The Costa Rican standard meridian is that of San José, $5^{\text{h}} 36^{\text{m}}$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

The severest storm of the month over the eastern Atlantic crossed the British Isles during the 15th and 16th, with lowest reported barometric pressure, 29.04 inches, at Stornoway, Scotland, on the latter date. A disturbance of moderate strength advanced from the southward over France and England during the 9th and 10th, and the barometer was relatively low over the British Isles from the 24th to 26th and on the 30th.

High barometric pressure prevailed in the vicinity of the Azores, except from the 8th to 11th, the lowest barometer and the maximum wind velocity of the month, 52 miles an hour from the southwest, occurring at Horta on the 8th.

From the 10th to 15th the barometer continued low over Cuba and, while no marked cyclonic disturbance appeared, torrential rains occurred over the eastern part of the island from the 10th to 13th.

The general disturbances that appeared over the United States were not severe in character, and no well-defined storm traversed the middle and south Atlantic, Gulf, or Pacific coasts.

Severe local storms were reported in Nebraska on the 1st, from the middle Mississippi and lower Missouri valleys to Oklahoma and Indian Territories on the 3d, in the Middle Atlantic States on the 5th, and in eastern New York on the 26th.

The termination of the warm wave of the third decade of the month was announced on the morning of the 25th by the following special forecast:

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The present warm wave will be broken in the lower Ohio Valley and the western Lake region to-night, in the upper Ohio Valley and the eastern Lake region Sunday, and in the Middle Atlantic States and western New England by Sunday night, and will be followed by two or three days of moderate temperature.

Early in the month floods became general in the streams of Kansas, and in rivers draining to the southward farm lands and railway tracks were submerged. Flood conditions also set in in the Arkansas and Red rivers during the first decade of the month. The Red River continued to rise at Shreveport until the 24th, when 28.5 feet was shown on the gage. For two weeks the Weather Bureau had sent out warnings that a stage of about 29 feet, the danger line, would be reached at Shreveport by the 25th.

On the 5th warning of a 27-foot stage in the Arkansas River at Little Rock was issued. The crest of the flood reached Little Rock on the 11th, when a stage of 27.8 feet, 4.8 feet above the danger line, was reached.

NEW ENGLAND FORECAST DISTRICT.

There were no violent storms along the coast. The monthly precipitation was below normal and unevenly distributed. Heavy frosts were reported in northern, and heavy to light frosts in southern sections, during the first decade of the month.—*J. W. Smith, District Forecaster.*

WEST GULF FORECAST DISTRICT.

No general storm occurred, temperature changes were slight, and showers frequent.—*I. M. Cline, District Forecaster.*

NORTH-CENTRAL FORECAST DISTRICT.

No storms of marked force crossed the upper Lakes, and warnings were ordered but once, on the 3d. The highest wind recorded during this storm was 60 miles an hour, from the northeast, at Duluth, Minn.—*H. J. Cox, Professor and District Forecaster.*

ROCKY MOUNTAIN FORECAST DISTRICT.

The month was unusually cool, with heavy rains on the eastern slope. For the frost that visited western Wyoming on the 25th warnings were issued on the morning of the 24th.—*J. H. Brandenburg, District Forecaster.*

SOUTH PACIFIC FORECAST DISTRICT.

The month was uneventful. On the morning of the 3d high winds occurred at Point Reyes, Southeast Farallon, and on Mount Tamalpais, while at San Francisco the wind was light. A light shower, that was forecast, occurred at San Francisco June 30. In a record of fifty-five years this is the only rainfall shown for June 30.—*A. G. McAdie, Professor and District Forecaster.*

NORTH PACIFIC FORECAST DISTRICT.

The month was dry and cool, and frosts occurred as late as the 25th, nearly all of which were forecast twenty-four hours in advance.

The lower Columbia River remained nearly on a stand slightly below 20 feet until the 13th, when it slowly fell until the end of the month.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

Destructive floods, due to excessive precipitation during the first few days of the month, occurred along the Arkansas, Red, and Kaw rivers, and their tributaries. The amount of property destroyed or damaged was large, and the loss to the farmers and planters on the bottom lands was especially heavy. All growing crops were badly washed, and in many instances completely destroyed.

A description of the flood conditions along the Arkansas River, prepared by Mr. E. B. Richards, official in charge, U. S. Weather Bureau office, Little Rock, Ark., follows:

The flood of June, 1904, in the lower Arkansas River, owed its inception to the general and excessive rainfalls during the first few days of the month in the valleys drained by the Arkansas and its tributaries. These rains caused a decidedly rapid rise at Fort Smith from the 3d to the 7th, inclusive; the stage at Fort Smith was 12.7 feet at 7 a. m. on the morning of the 3d, and 21.5 feet on the following morning, a rise of 8.8 feet in twenty-four hours. In consequence of this rapid rise at Fort Smith, this office at once called for special readings at Fort Smith and Dardanelle for the 5th, 6th, and 7th. Flood warnings were issued on the 4th to points above and below Little Rock, forecasting a stage of 27.0 feet at Little Rock, just 0.9 foot lower than the highest stage reached by the disastrous flood of 1892, and 0.5 foot lower than the flood of April, 1898, when the lowlands along the Arkansas, from Little Rock to the mouth, were overflowed and devastated. This warning was widely disseminated by telegraph, telephone, and through the mails and the press. On the morning of the 5th another flood bulletin was issued and the warning disseminated, and bulletins were posted in prominent public places throughout the city.

The crest of this rise reached Little Rock on the 11th, and a maximum stage of 27.8 feet was attained at 7 p. m. of that date. The danger line was passed during the night of the 5th and was exceeded 14 consecutive days thereafter. At 7 p. m. of the 5th the stage at Little Rock was 22.6 feet, only 0.4 foot below the danger line; at 7 a. m. of the 6th the stage was 24.7 feet, a rise of 11.6 feet since the morning of the 5th. On the 8th warnings were sent out by mail forecasting a stage in excess of 27.0 feet. The river continued to rise slowly until the 12th. On the morning of that date the gage read 27.7 feet; at 7 p. m. it read 27.8 feet, the highest stage since 1892, being just 0.1 foot lower than the highest stage of the flood of that year, and 0.3 foot higher than the maximum stage forecast by the Weather Bureau.

The Little Rock Board of Trade, appreciating the value of these warnings, and realizing the great damage that would result from such a stage at Little Rock, chartered the steamer *Henry Sheldon*, and held her in readiness to start at a moments notice to render assistance to the dwellers in the lowlands along the Arkansas River. This precaution, while wise and timely, proved to be unnecessary, for the inhabitants of the

lowlands had not forgotten the terrible destruction caused by the floods of 1892 and 1898, which had been predicted by the Weather Bureau, and, with the great calamities which attended those floods still fresh in their memories, they acted promptly upon the first note of warning, and moved all of their stock and movable property to places of safety, and every precaution was taken to save life and property. The Arkansas Gazette, in the issue of the 8th, said: "Up to the present time it is believed there has been no loss of life, and this is attributed to the early warnings sent out by the Weather Bureau. Section Director Richards made his prediction of a 27.0-foot stage on Saturday, and as a consequence occupants of the lowlands received ample warning."

The warnings had been sent out in ample time to enable people to move their stock and property to places of safety. Levees were strengthened or built higher and new levees were constructed in some heretofore unprotected localities. Notwithstanding the precautions taken and the extra work done, many levees were broken by the high water with its swift current (consequent upon the low stage of the Mississippi River), and many thousands of acres of growing and flourishing crops destroyed, thousands of acres of land inundated and washed away, and houses and fences swept away by the relentless torrent.

The damage done by this flood along the Arkansas, from Fort Smith to the mouth, was greater than by any flood heretofore experienced, for the reason that more land in the bottoms was under cultivation, and it was too late in the season for the farmers to replant their devastated fields after the water had receded.

Navigation was seriously interrupted, as landing at many points along the river was difficult and dangerous; boats could not pass under the bridges, nor could they breast the swift running current.

The fall was slow and steady from the 12th to the 28th, when, by reason of the heavy rains of the 28th in the tributary branches in the upper Arkansas, which were augmented by continuous local rains in the lower valley, the river began to rise again at Fort Smith and Dardanelle, and at Little Rock on the 30th; this rise was only temporary and not serious, and no further damage was done.

A rapid rise occurred in the Kaw River and its tributaries on the 3d, and as weather conditions favored a continuance of the heavy rains, a repetition of the disastrous floods of the spring of 1903 was feared. Fortunately, the rains ended on the 5th, but in the meantime many of the smaller streams had reached a flood stage, with a consequent overflowing of all property interests along their courses. About one-fourth of Newton, Kans., was overflowed; many persons were rendered homeless, and much valuable property lost or damaged.

At Emporia, Kans., three inches of precipitation fell within a few hours, and the Cottonwood River rose at the rate of six inches an hour, flooding the business portion of the town and destroying much property.

The floods along the Red River were also of a severe character and were the cause of heavy losses, particularly to growing crops on the lowlands.

The following report regarding these floods is furnished by Mr. J. W. Cronk, official in charge, United States Weather Bureau office, Shreveport, La.

From June 9 to 20, inclusive, the Red River was above the danger line of 28 feet at Fulton, Ark., the highest stage, 31.6 feet, being recorded on June 13 and 14. Above Fulton, at Arthur City, Tex., the river reached a stage of 23 feet on June 6 and 24 feet on June 13. Below Fulton, at Shreveport, the river rose to its highest stage, 28.5 feet, on June 24 and 25. The flood was caused by heavy rainfall unevenly distributed over the upper watershed of the Red River from June 3 to 9.

Prompt warnings from the Weather Bureau prevented loss of life, livestock, household goods and other portable property in the overflowed districts, which embraced the unprotected lowlands in the Red River Valley, in Arkansas and northern Louisiana, above Shreveport. Damage to crops (principally cotton), however, was heavy, many thousands of acres of cultivated bottom lands being unprotected by levees.

The press, levee officials, including the State's Chief Engineer, and the people, without exception, have praised the work of the Bureau in no uncertain words. That this praise is deserved may be judged from the fact that warnings issued from two to ten days in advance were noticeable for their correctness, giving nearly the exact date and height of the flood stage.

As to the benefits derived from warnings, above \$100,000 is the nearest estimate that can be made at this time of the value of property protected and saved, and that amount would not cover the unavoidable loss in the cotton crop.

The forecasts of weather and river stages by the Weather Bureau during these floods were very accurate and received the commendation of the press and public generally. Farm-